CLAIMS

What is claimed is:

1. A core bit, comprising:

a bit body having a face surface with a throat opening thereinto, said throat extending to a longitudinal cavity;

at least one cutter disposed on said face surface;

at least one port outlet disposed on said face surface;

at least one bore extending through said bit body having one end in fluid communication with said at least one port outlet; and

at least one conical shaped port inlet opening into said longitudinal cavity and in fluid communication with another end of said at least one bore.

2. A core bit, comprising:

a bit body having a face surface with a throat opening thereinto, said throat extending to a longitudinal cavity;

at least one cutter disposed on said face surface;

at least one port outlet disposed on said face surface;

at least one bore extending through said bit body having one end in fluid communication with said at least one port outlet; and

at least one port inlet including a first end having a first cross-sectional area joined to another end of said at least one bore and extending to a second end having a second cross-sectional area larger than said first cross-sectional area and opening into said longitudinal cavity.

3. The core bit of claim 2, wherein said at least one port inlet comprises a generally conical shape.

4. The core bit of claim 2, wherein said at least one port inlet comprises a generally pyramidal shape.

5. A core barrel assembly for cutting core samples in subterranean formations, comprising:

an outer barrel having one end attached to a drill string;

an inner barrel assembly rotatably disposed inside said outer barrel, said inner barrel assembly including an inner tube and a core shoe attached to one end of said inner tube;

a core bit attached to an opposing end of said outer barrel proximate said core shoe, said core bit including:

a bit body having a face surface with a throat opening thereinto, said throat extending to a longitudinal cavity;

at least one cutter disposed on said face surface;

at least one port outlet disposed on said face surface;

at least one bore extending through said bit body having one end in fluid communication with said at least one port outlet; and

at least one port inlet including a first end having a first cross-sectional area joined to another end of said at least one bore and extending to a second end having a second cross-sectional area larger than said first cross-sectional area and opening into said longitudinal cavity.

6. The core barrel assembly of claim 5, wherein said at least one port inlet comprises a generally conical shape.

7. The core barrel assembly of claim 5, wherein said at least one port inlet comprises a generally pyramidal shape.

8. A core bit for attachment to a core barrel assembly, said core barrel assembly including an outer barrel, an inner tube disposed within said outer barrel, and a core shoe disposed at one end of said inner tube, comprising:

a bit body including a face surface and further including an inner, substantially cylindrical, longitudinally extending cavity bounded by an inside diameter of said bit body, and configured to receive at least said core shoe therein;

wherein a flow path is defined by an annular region bounded by said inside diameter of said bit body and an outside diameter of at least said core shoe;

at least one cutter disposed on said face surface;

at least one port outlet disposed on said face surface;

at least one bore extending through said bit body having one end in fluid communication with said at least one port outlet; and

at least one port inlet in fluid communication with another end of said at least one bore, said at least one port inlet forming an angle of approach relative to said flow path defined by said annular region of between about zero and 44 degrees.

9. The core bit of claim 8, wherein said angle of approach is about 30 degrees.

10. A core barrel assembly for cutting core samples in subterranean formations, comprising:

an outer barrel having one end attached to a drill string;

an inner barrel assembly disposed inside said outer barrel, said inner barrel assembly including an inner tube and a core shoe attached to one end of said inner tube;

a core bit attached to an opposing end of said outer barrel proximate said core shoe, said core bit including:

a bit body including a face surface and further including an inner, substantially cylindrical, longitudinally extending cavity bounded by an inside diameter of said bit body, at least said core shoe extending into said cavity;

wherein a flow path is defined by an annular region bounded by said inside diameter of said bit body and an outside diameter of at least said core shoe;

Sub A7

at least one cutter disposed on said face surface;

at least one port outlet disposed on said face surface;

at least one bore extending through said bit body having one end in fluid communication with said at least one port outlet; and

at least one port inlet in fluid communication with another end of said at least one bore, said at least one port inlet forming an angle of approach relative to said flow path defined by said annular region of between about zero and 44 degrees.

11. The core barrel assembly of claim 10, wherein said angle of approach is about 30 degrees.

12. A core bit for attachment to a core barrel assembly including a core shoe of a predetermined exterior configuration, said core bit comprising:

a bit body including a face surface and further including an inner, substantially cylindrical cavity longitudinally extending therethrough;

at least one cutter disposed on said face surface;

at least one port outlet disposed on said face surface;

at least one bore extending through said bit body having one end in fluid communication with said at least one port outlet; and

at least one port inlet in fluid communication with another end of said at least one bore;

said at least one port inlet opening into said cavity at a region thereof defining an annular reservoir of a first volume between an inside wall portion of said cavity and an outside wall portion of said core shoe when disposed in said cavity; and

an inside wall portion of enlarged diameter providing, with said core shoe, an annular reservoir having a second volume up to 70 percent larger than said first volume.

13. A core bit for attachment to a core barrel assembly, said core barrel assembly including an outer barrel, an inner tube disposed within said outer barrel, and a core shoe of a predetermined exterior configuration disposed at one end of said inner tube, comprising:

a bit body including a face surface and further including an inner, substantially cylindrical cavity longitudinally extending therethrough, at least said core shoe extending into said cavity;

at least one cutter disposed on said face surface; and

at least one surface feature disposed on a wall of said cavity configured to individually impart resistance to fluid flow in a narrow annulus defined by said wall of said cavity and an outside surface of said core shoe.

14. The core bit of claim 13, wherein said at least one surface feature is selected from the group consisting of: at least one annularly extending squared edge; at least one annular, rectangular cross-sectional relief; at least one annular, triangular cross-sectional relief; and at least one annular, circular cross-sectional relief.

15. A core barrel assembly for cutting core samples in subterranean formations, comprising:

an outer barrel having one end attached to a drill string;

an inner barrel assembly disposed inside said outer barrel, said inner barrel assembly including an inner tube and a core shoe of a predetermined exterior configuration attached to one end of said inner tube;

a core bit attached to an opposing end of said outer barrel proximate said core shoe, said core bit including:

a bit body including a face surface and further including an inner, substantially cylindrical cavity longitudinally extending therethrough, at least said core shoe extending into said cavity;

at least one cutter disposed on said face surface; and

at least one surface feature disposed on a wall of said cavity configured to individually impart resistance to fluid flow in a narrow annulus defined by said wall of said cavity and an outside surface of said core shoe.

SUB A17

16. The core barrel assembly of claim 15, wherein said at least one surface feature is selected from the group consisting of: at least one annularly extending squared edge; at least one annular, rectangular cross-sectional relief; at least one annular, triangular cross-sectional relief; and at least one annular, circular cross-sectional relief.

17. A core bit for attachment to a core barrel assembly, said core barrel assembly including an outer barrel, an inner tube disposed within said outer barrel, and a core shoe of a predetermined exterior configuration disposed at one end of said inner tube, comprising:

a bit body including a face surface and further including an inner, substantially cylindrical, longitudinally extending cavity bounded by a wall of said cavity, at least said core shoe extending into said cavity;

wherein a flow path is defined by an annular region bounded by said wall of said cavity and an outside surface of at least said core shoe;

at least one cutter disposed on said face surface;

at least one port outlet disposed on said face surface;

at least one bore extending through said bit body having one end in fluid communication with said at least one port outlet; and

at least one port inlet opening into said annular region and including a first end having a first cross-sectional area joined to another end of said at least one bore and extending to a second end having a second cross-sectional area larger than said first cross-sectional area, said at least one port inlet forming an angle of approach relative to said flow path defined by said annular region of between about zero and 44 degrees.

18. The core bit of claim 17, further comprising at least one topographical feature disposed on said wall of said cavity configured to individually impart resistance to fluid flow in a narrow annulus defined by a portion of said wall of said cavity below said annular region and an outside surface of said core shoe.

Sub A17

19. A port structure for delivering drilling fluid to a face surface of a core bit, comprising:

a port outlet disposed on said face surface;

a bore extending through said core bit having one end in fluid communication with said port outlet; and

a port inlet including a first end having a first cross-sectional area joined to another end of said bore and extending to a second end having a second cross-sectional area larger than said first cross-sectional area.

20. The port structure of claim19, wherein said port inlet comprises a generally conical shape.

21. The port structure of claim 19, wherein said port inlet comprises a generally pyramidal shape.

22. A port structure for delivering drilling fluid to a face surface of a core bit attached to a core barrel assembly, said core barrel assembly including an outer barrel, an inner tube disposed within said outer barrel, and a core shoe disposed at one end of said inner tube adjacent said core bit, at least said core shoe extending into an inner, substantially cylindrical cavity longitudinally extending into said core bit, wherein a flow path is defined by an annular region bounded by a wall of said cavity and an outside surface of said core shoe, said port structure comprising:

a port outlet disposed on said face surface;

a bore extending through said core bit having one end in fluid communication with said port outlet; and

a port inlet in fluid communication with another end of said bore, said at least one port inlet forming an angle of approach relative to said flow path defined by said annular region of between about zero and 44 degrees.

23. The port structure of claim 22, wherein said angle of approach is about 30 degrees.

24. A method of reducing a quantity of fluid flowing from an annular region bounded by a wall of a cavity through a core bit and an outside surface of a core shoe disposed therein, and into a narrow annulus therebelow defined by said wall of said cavity and said outside surface of said core shoe, said narrow annulus in fluid communication with said annular region, the method comprising:

enlarging a cross-sectional area of each port inlet of a plurality of ports relative to a cross-sectional area of a bore of each port of said plurality of ports, said each port inlet of said each port in fluid communication with said annular region; and

receiving fluid from said annular region into said enlarged cross-sectional area of said each port inlet.

25. A method of reducing a quantity of fluid flowing from an annular region bounded by a wall of a cavity through a core bit and an outside surface of a core shoe disposed therein, and into a narrow annulus therebelow defined by said wall of said cavity and said outside surface of said core shoe, said narrow annulus in fluid communication with said annular region, the method comprising:

imparting an angle of between about zero and 44 degrees between said flow path and each port inlet of a plurality of ports in fluid communication with said annular region; and

receiving fluid from said annular region into said each port inlet.

26. A method of reducing fluid flow into a narrow annulus defined by an inside surface of a core bit and an outside surface of a core shoe extending into said core bit, comprising:

imparting circumferential flow to fluid collecting in an annular reservoir in fluid communication with said narrow annulus; and

receiving said circumferentially flowing fluid in a plurality of ports in fluid communication with said annular reservoir.

27. A method of reducing fluid flow in a narrow annulus defined by an inside surface of a core bit and an outside surface of a core shoe extending into said core bit, comprising creating fluid recirculation zones along said inside surface of said core bit to impart resistance to fluid flow in said narrow annulus.